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# Fishery Conservation in River Reservoirs
# Final Report from FAK (The imposition of fishery conservation measures in power plant rservoirs, Part I)

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FISHERY CONSERVATION IN RIVER RESERVOIRS

Final Report from FÅK (The imposition of fishery conservation measures in power plant reservoirs, .), part 1

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## 1. SUMMARY

A large number of the rivers and lakes in Sweden are used for hydro-electrical purposes. Fishing in such areas has been seriously affected. Measures for fishery conservation have been taken earlier, above all in the large regulated lakes and to benefit populations of salmon and salmon trout migrating to the sea. The need for measures is equally prevalent in the river reservoirs, but methods for fishery conservation in these areas have, to a large extent, been absent. In order to solve this problem, a cooperative project was initiated in 1976 between the Fisheries Department and power companies for research on the imposition of fishery conservation in power plant reservoirs (FÅK). The research was financed by the power companies. The objective was to investigate the conditions for fish production, to attempt the planting of salmon trout and other fish species and to perform experiments with measures for biotope improvement in river reservoirs as well as to construct fishing equipment for use in these areas. The project was terminated in 1985.

Three rivers were chosen and, in each river, three river reservoirs selected as test areas: Ligga, Messaure and Porsi in Stora Luleälven, Gammelänge, Hammarforsen and Järkvissle in Indalsälven as well as Krokströmmen, Storåströmmen and Laforsen in Ljusnan. Indalsälven is, naturally, the most productive of these rivers, and the short-term regulation in this river is not as comprehensive as it is in the other two.

A river which is used entirely for hydro-electric production, consists of stepped river reservoirs. The resulting effects on the environment are principally of two kinds: Those caused by the regulation of the river flow and those caused by the

building of dams. The regulation of the river flow is done partly on a long-term, partly on a short-term basis. The latter, that is the short-term regulation, can occasionally even include release, which means that the waters of the river come to a standstill. The regulation of the river flow influences the velocity of the water and, consequently, also the materials on the bottom as well as the flora and the fauna. The water level also is regulated, which usually means that a regulation zone comes into being. This zone is drained, when the surface of the reservoir is lowered in connection with short-term regulation.

The building of dams causes prevention of fish migration, flooding of the surrounding area, and a change in the transport of materials by the river. Sand and silt are deposited in those river stretches that are more lake-like (the dammed up parts) and closest to the dams upstream. In the remaining parts of the reservoir ( inlet parts), the current velocity is higher, and the bottoms consist of stone and rocks. The inlet parts are usually cleared and sometimes canalized.

In the inlet parts of the river reservoir, a fauna exists on the bottom of the stream which deviates, to a larger or smaller extent, from the one that exists in an unregulated river, depending on the extent of the regulation. This fauna is influenced by such environmental factors as the velocity of the current, drainage of bottoms, access to food and temperature. The amount of bottom-living animals transported with the stream (so-called drift ) is lower in the regulated river, as is the number of species. When a release takes place, it is

obvious that the drifting cómpletely ceases. In certain stretches of the river, the decrease in drift of bottom-living animals is compensated for by the drift of lake-inhabiting animals. The bottom fauna community of the dammed-up parts re_sembles the one found in slack river waters or in a lake. Conditions for production in the dammed-up parts depend, among other things, on the extent of regulation of the water level.

The conditions for salmon trout, above all, but also for grayling, have deteriorated in rivers after their development. The populations of pike, perch and roach, on the other hand, have benefitted. These species, together with whitefish, constituted the main part of the haul during fishing with nets in the investigated reservoirs. The largest hauls were taken in Indalsälven and the smallest in Luleälven, while Ljusnan occupied an intermediate position.

Grayling and pike were subjected to special investigations. Grayling is the subject of rather extensive sports fishing in certain regulated rivers. The grayling population density proved to be high in the inlet part of a reservoir in Indalsälven. Pike is the most important predatory fish in the river reservoir. There, it presents one of the most significant threats against planted salmon trout. In a certain pike population under investigation, density was high and growth slow. The movements of pike were investigated by means of radio transmitters in two reservoirs. Large pike moved over long distances and were even found staying in the more rapidly flowing parts.

Fishing in the rivers has been influenced by changes both in the supply of different fish species and in the technical qualifications

of fishing equipment. Fishing with nets is relatively significant in the lake-like reservoirs. In the continuous-flow reservoirs that FÅK investigated, fishing with nets proved to be less extensive. Fishing pressure varied from one river to another. It was lower in Ljusnan than in Luleälven and Indalsälven. Even the attitudes of the fishermen towards the different fish species varied between the different rivers.

Fishing for salmonid fish is the most appreciated. There is consequently a demand, first of all, for planting of salmon trout, Arctic (Canadian) char and grayling. Approximately 20 000 tagged salmon trout of a number of different progenies were planted bv FÅK in 8 river reservoirs. This material has been complemented with the results from salmon trout plantings in reservoirs belonging to other rivers. The planting experiments were, among other things, intended to shed light on variations in behaviour between migrating and stationary progenies of salmon trout. The relationship between stationary behaviour of planted fish and recovery results was also studied, as well as the impact of its size. Finally, an investigation was undertaken of which salmon trout progenies were suitable for the different types of reservoir.

The results of the salmon trout plantings varied considerably, from a few % recovered fish to a maximum of 41% for continuous-flow reservoirs and 55% for lake-like reservoirs. Salmon trout progenies with stationary behaviour in their natural environment gave higher recovery rates in continuous-flow reservoirs, both in the original planting reservoir as well as totally, when compared to migrating progenies. Furthermore, a connection existed between the length of the salmon

trout at planting and the recovery rate. These results are confirmed by experiments with radio transmitters, which were conducted with salmon trout. The transmitter experiments showed besides the importance of pike as a predator of newly planted salmon trout. Of the salmon trout that participated in the experiment, close to 60% were killed by pike within 4 days.

Planting of Arctic (Canadian) char was tried in three reservoirs, which were considered suitable for the species, i.a. because of their sufficient depth. The recovery rates varied considerably even for this species, from 1 to 45%. The best recovery results were reached with the largest fish. The fish were mainly caught by nets.

Experiments with supplementary planting of grayling were conducted in two reservoirs with one-season (summer) fish. The results are difficult to evaluate but seem to indicate that the method, in certain cases, can prove useful. The planting of Danube trout was planned but could not be executed due to safety regulations against infectious diseases. The plantings of pike-perch which were made in Ljusnan gave no recoveries.

In an affluent to Luleälven, an experiment was conducted with fertilization in order to improve the local production of salmon trout. Whole grain and concentrated feed based on sugar beets were used as fertilizers. The amount of animals living on the bottom increased 2-3 times in the fertilized stretch. The production of salmon trout increased with 50-70%, which, above all, was due to an increase in the population density.

In a side channel of Ljusnan, an electric current-generator was installed which maintained a constant water flow, even during release conditions in the river. The intention was to use this shore channel as a growing area for salmon trout. It soon became evident, however, that variations in water levels were too large. The salmon trout which were planted in the channel abandoned it after a very short time.

Masses of rocks were placed experimentally in two reservoirs as fishery conservation measures. In Ljusnan, the placing of the stones was combined with a planting of crayfish. It was not possible to establish any regeneration among these. However, the stone heaps enriched the supply of organisms suited for fish food.

Fishing with nets in river reservoirs is greatly obstructed by the presence of flooded tree stumps, branches etc. Nets placed on the bottom and equipped with various types of protection against adherence to the bottom were tested. The tested nets were compared to standard nets with regard to amount of haul, extent of adherence to the bottom as well as unraveling and overhauling times. The final product is a net equipped with flat, moulded plastic stilts. This net on plastic stilts gives only 80% of the consumption-fish catch that a standard net produces, but its life-span is twice as long.

Experiments with floating nets were also conducted in order to investigate the possibilities of catching fish in free water. The catches were, however, low. The nets produced badly due to currents and sliming.

A bottom-fishing equipment (Swedish :"mjarsa") was constructed.

It consisted of an an aluminium frame with netting stretched around it. The size of the frame as well as the design of the entrance were varied. The largest haul was achieved with an apparatus of the size 2 x 2 x 1.5 m. The funnel-shaped entrance should be placed centrally or in a low position, depending on the fishing object (pike or perch).

Furthermore, the text contains recommendations for fishery conservation measures based on the results reported. Chapter 10 is dedicated to promoting the ideas that emerged during the course of the investigation.